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Technical Report 429

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**RELIABILITY OF A MEASURE OF INSTITUTIONAL
DISCRIMINATION AGAINST MINORITIES -**

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Dwight J. Goehring

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Technical Report 429

RELIABILITY OF A MEASURE OF INSTITUTIONAL DISCRIMINATION AGAINST MINORITIES

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JREWORD

Since 1972 the Army Research Institute for the Behavioral and Social Sciences (ARI) has conducted technical research in support of the Army's Equal Opportunity Program. In 1974 ARI, under contract, documented the existence of institutional discrimination in the Army. The document, published first as ARI Technical Paper 270 and later as DA PAM 600-43, sets forth a basic measurement system for monitoring equal opportunity status. ARI technical report TR-78-B13, also developed under contract, adapts the measurement system for use at Major Command, post, or brigade levels. This report, produced in-house at the ARI Field Unit at the Presidio of Monterey, California, addresses specific problems in applying the measurement procedures to relatively small groups and the possible solutions to such problems. Research was accomplished in response to requirements of the Office of Equal Opportunity Programs, DAPE-HRE, and to Army Project 2Q163744A769, "Army Contemporary Issues," FY 1978 Work Program.

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RELIABILITY OF A MEASURE OF INSTITUTIONAL DISCRIMINATION AGAINST MINORITIES

BRIEF

Requirement:

To analyze in some detail the statistical properties and general operating characteristics of a measure of institutional discrimination against minorities which has been recommended for use at Major Command, post, or brigade levels.

Procedure:

Both general and computer-assisted analytical procedures were used. A number of examples are used to clarify the points.

Findings:

The relevant concepts are defined and explained. Complete as well as short-cut procedures for assessing the reliability of the measure are presented and discussed.

Utilization of findings:

The information resulting from this research endeavor should enable both other researchers in the area and general users of the measure to have a better understanding of its technical characteristics and ultimately make more effective use of it as a management tool.

RELIABILITY OF A MEASURE OF INSTITUTIONAL DISCRIMINATION AGAINST MINORITIES

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RELIABILITY OF A MEASURE OF INSTITUTIONAL DISCRIMINATION AGAINST MINORITIES

INTRODUCTION

Institutional racism (Knowles and Prewitt, 1969) is generally contrasted with personal racism. The latter can be defined as actions taken by one or more individuals with intended malice based upon prejudice against persons of another race. While differing definitions of institutional racism have been suggested in the literature, here it can be generally conceptualized as any negative impact upon a specific race of people resulting from routine operations or procedures of an organization or other suprapersonal structure. These two types of racism are not unrelated. Indeed, in specific instances, they may be symmetrically causative. A primary distinction between them is their differing mode of impact: impersonal compared to personal. To generalize the concept of institutional racism to institutional discrimination against minorities requires only the awareness that similar mechanisms may operate against aggregations of people based upon communalities other than race.

Feagin (1978) distinguishes two types of institutional discrimination: direct, where there is intent to harm the minority group in question, and indirect, where no intent exists. The indirect variety is of particular interest. It can develop and operate not only without intent but without anyone's awareness. Feagin notes that indirect institutional discrimination has two common forms: side-effect and past-in-present discrimination. The former is exemplified by the use of some selection variable, either correlated with performance criteria or not, which differentially rejects disproportionately large numbers of minority individuals. Past-in-present discrimination concerns past inequities or injustices which place minority members at a disadvantage in some current, ostensibly equitable circumstance involving selection.

MEASUREMENT OF INSTITUTIONAL DISCRIMINATION

A statistic termed the Difference Indicator (D.I.) has been developed under contract for the U.S. Army which can measure institutional discrimination. It has been applied to a wide range of variables with specific reference to the status of black American soldiers (DA PAM 600-43). The study found overrepresentation of blacks in areas such as military justice actions and underrepresentation in areas such as promotions. The pattern of overrepresentation and underrepresentation of blacks in the Army at the time of investigation was clearly and consistently to their disadvantage. The D. I. system has recently been recommended for use at division and brigade levels (Nordlie, Edmonds & Goehring, 1978).

The D.I. takes the general form of a ratio of the proportion of individuals selected for the category or dimension of interest who belong to the minority group to the proportion of minority group members in the eligible population for the category. The ratio is subjected to a linear transformation, multiplied by 100 minus 100. Thus,

$$D. I. = \frac{P}{\pi} \times 100 - 100, \text{ where} \quad (1)$$

P = the proportion of persons selected for a category who are minority group members, and

π = the proportion of all eligible persons who are minority group members.

Under the assumption that all factors leading to category inclusion are constant between minority and majority group eligibles it follows that the probability of inclusion in the category is statistically independent of group membership. Under this assumption it can be shown that the expected value of the D.I. is zero. Resulting positive values of the index can be interpreted as percent of minority overrepresentation and negative values as percent of underrepresentation. These interpretations disregard sampling variability.

When a D.I. is calculated for a population or where all frequency counts are large, any D.I. with an absolute value which is moderate or large leads the researcher to reject the assumption that all factors are constant. However, when a D.I. is of small magnitude or at least one frequency is small or when an inference from a sample to a population is made the researcher has to decide whether the assumption should be rejected. If any nonzero D.I. value is taken as grounds for a decision to reject the assumption, the researcher risks the expenditure of resources studying a situation in which the assumption may be valid. The pages to follow are intended to facilitate just such a decisionmaking process in the hope of minimizing the misdirection of energy and resources.

An algebraically equivalent expression of the D.I. is produced by considering the Actual Number of minority individuals who are observed in the category of interest in comparison to the Expected Number, which is the proportion of the eligible population which is minority multiplied by the total number of persons selected for the category. Thus, the Difference Indicator can be expressed:

$$D.I. = \frac{\text{Actual Number}}{\text{Expected Number}} \times 100 - 100 \quad (2)$$

This form of indicator, computed from integers and incorporating an explicit standard of comparison may be less mathematically elegant, but is perhaps more easily comprehended. It may also help to clarify that a D.I. value of zero is anticipated only when selection for inclusion in a category is independent of group membership. Which formula is used for computation is primarily a matter of convenience. Actually, each requires the same information.

The D.I. can only measure the effects of institutional discrimination upon minority group representation in the category. A single value can provide no information regarding the causes of the results. Furthermore, the magnitude of a D.I. is not affected by any discrimination factors which temporally precede the delimitation of the eligible population. For example, suppose that specifically due to past discriminatory hiring practices in the Widget Corporation, there are very few women in junior executive positions. When a D.I. is calculated for evaluation of promotions of women to senior executive slots based upon junior executives as the eligible group, any past influence upon the likelihood of women filling the senior executive jobs is ignored. Thus, the D.I., in general, will tend to underestimate the extent of past-in-present forms of institutional discrimination.

The above example underscores the importance of the specific characteristics of the eligible population in influencing the value of the D.I. Consider an additional D.I. using the same promotion situation, however, based upon a less narrow group of eligibles. All female employees in the company are counted among those eligible. To the extent that a greater proportion of the total employees than of the junior executive population is female, the new D.I. will be more negative, now reflecting past direct and indirect discriminatory practices toward female employees. If there were current discrimination against women as reflected by their diminutive numbers at all levels of the company, the D.I. could only detect it if the eligible group were taken as applicants or some other appropriately general population.

In a similar manner, a series of D.I.s for a given dimension can be calculated for increasingly specific groups of eligibles. Whenever the basis for refinement of the eligible group is correlated with the probability of inclusion in the category, the magnitude of the D.I. will be influenced. Continuing with the same example, if one of the rules for promotion to senior executive were employment with the company for 20 or more years, a restricted eligible group might be defined as junior executives having at least 20 years of employment. If in the redefined eligible group proportionately more females than males were eliminated from the eligible group, the new D.I. would be less negative than the previous value. Furthermore, in general the variable thus controlled

for--time with the company in this case--would be identified as a producing factor. Clearly, such a variable could be mediating for other variables, including direct institutional discrimination, and should not be simplistically interpreted as causative per se. Successive variables can be controlled for in this manner. Any which produces no change in the D.I. can be identified as extraneous to the category under study. Thus, procedures are available for investigating variables which may or may not be related to any specific situation.

In many applications of the D.I. the numbers used for calculation of the required proportions are sufficiently small that it is advisable to assess the magnitude of random variability upon the indicator. Two specific problems in reliability frequently arise. The first concerns the reliability of a single D.I. value. The second relates to the reliability of differences among D.I.s. The problems can be phrased in other words as a decision whether a numerically small D.I. value of difference between two D.I.s should be judged as due merely to chance or to other factors.

RELIABILITY OF DIFFERENCE INDICATOR VALUES

A method for testing whether a single D.I. is different than zero when the relevant frequencies are large has been suggested by Nordlie and Ghosh. In this case π may be considered a parameter and \underline{p} tested against it. Under a null hypothesis that D.I. equals zero, confidence intervals for the desired alpha level can be established based on:

$$SD = (100 \sqrt{\pi(1-\pi)/n})\pi, \quad (3)$$

where \underline{n} equals the number of minority individuals in the eligible population. Use of this procedure is not recommended if any of the frequency counts involved is less than 25.

Suppose a researcher at Wearout Products, which has 2,500 employees, decides to investigate whether disproportionate numbers of minority individuals have been laid off during a business slump. The relevant parameters are observed as follows: $\pi = 500/2500 = .20$ (proportion of employees who are minority group members), $\underline{n} = 250$ (total number of employees laid off), $\underline{p} = 80/250 = .32$ (proportion of persons laid off who are minority group members), and the alpha level is set at .05. Calculation of the D.I. yields a value of 60. SD equals 12.65. Therefore, the critical region bounds are given by

$$\pm Z_{1-(\alpha/2)}SD. \quad (4)$$

For this example the bounds are -24.8 and 24.8. The obtained D.I. lies outside. Thus, the researchers concludes the D.I. is not zero and that some factor other than chance is operating in this situation. Next, an attempt would be made to identify specific correlates with the disparate situation, perhaps by calculating additional D.I. values based upon modified eligible populations.

When the numbers involved in the calculation of a D.I. are not extremely small the null hypothesis that $D.I. = 0$ can also be appropriately tested using a chi-square test with one degree of freedom and Yate's correction. If the values are extremely small, Fisher's exact test could be used (Hays and Winkler, 1971). Figure 1 shows the numerical values needed. The estimates of \underline{p} and π are $a/(a + b)$ and $(a + c)/N$, respectively. It can be seen that for any given situation where a D.I. is calculated a 2 x 2 table can be constructed. Note, however, that while any 2 x 2 table determines a unique D.I. value, the reverse is not true.

		Category Membership		
		yes	no	
Minority Group Member	yes	a	b	a + b
	no	c	d	c + d
		a + c	b + d	N

Figure 1. Numerical values for calculating a difference indicator.

Since calculations of chi-square statistics can be tedious and many potential users of the D.I. may be discouraged by the necessity of such endeavors, a short-cut method for testing index values was sought. The Monte Carlo method seemed promising. A computer program was prepared which systematically examined more than 2.0×10^4 selected 2×2 tables, calculating corrected chi-square values for each. Tables for which the probability of a chance occurrence was less than .05 were more carefully analyzed. An examination of "worst cases" revealed that the set of distributions among the 2×2 tables significant at the .05 level could be summarized by values derived from the tables without too severe a power loss compared to the testing of individual tables. Figure 2 presents the results of the analysis, displaying D.I. values as a function of the Expected Number of minority individuals, which in the notation of Figure 1 is equivalent to $(a + c)(a + b)/N$. When the Expected Number of minority individuals is less than six, Fisher's exact test may be applied.

In the derivation of the function presented in Figure 2 it was necessary to invoke several assumptions of which users should be cognizant. The number of minority individuals in the total eligible population has been assumed to be less than half of the total. Further, the selection ratio, $(a + c)/N$, has been assumed not to exceed .25. If in a specific case either of these circumstances does not hold, it is recommended that the chi-square test be conducted rather than depending upon the values in the figure.

RELIABILITY OF DIFFERENCE INDICATOR DIFFERENCES

The second problem arises as the situation where one wishes to compare two D.I. values, seeking to determine whether they differ significantly. This need arises when D.I.s from different time intervals are available or when organizations are being compared. A computer study of the variables comprising the ratio lead to the conclusion that direct comparison of D.I. values involves several practical difficulties. Identical D.I. values can reflect drastically different 2×2 tables, and more seriously, very large D.I. differences can be produced which do not reflect important differences between the respective underlying 2×2 tables. Hence, a test was developed based upon P , the proportion of persons in the category of interest who are minority group members. The basic procedure is as follows:

First, from the two Expected Numbers used to calculate the two D.I. values being compared, select the smaller and call it the Minimum Expected Number, MEN. Next, for each D.I. calculate the Minority

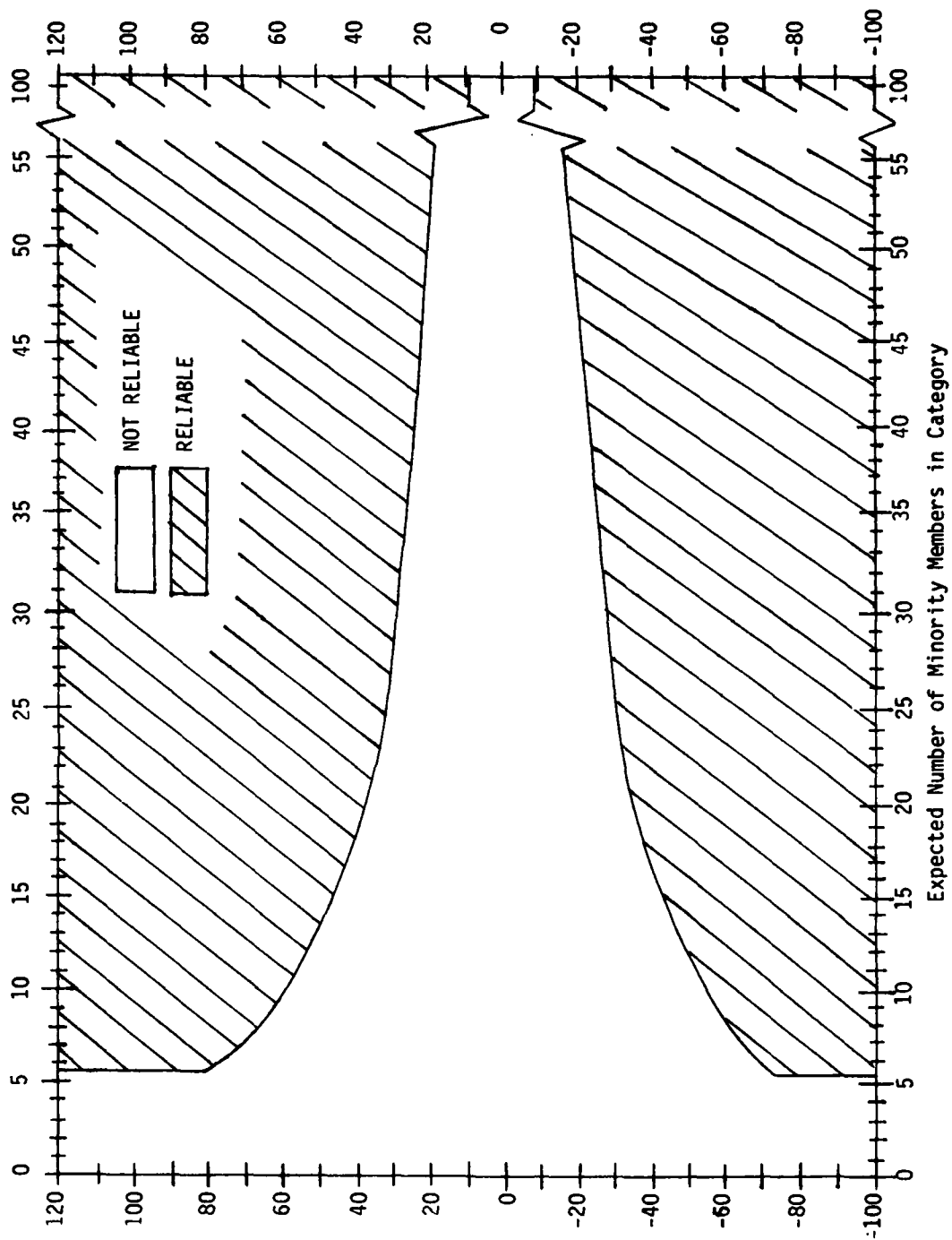


Figure 2. Reliability of difference indicator values.

Incidence Rate, MIR, which equals the Actual Number of minority individuals in the category divided by the Total Number of individuals in the category. Next, subtract the smaller MIR from the larger MIR to obtain the difference between the values, MIRD. Finally, locate the value in Table 1 which is nearest to the obtained MEN. If the MIRD is greater than the value in the table, the difference in Ps underlying the D.I. values is significant at the .05 level.

Table 1

DIFFERENCE BETWEEN TWO DIFFERENCE INDICATOR VALUES

Minimum Expected Number	Minority Incidence Rate Difference
10	.20
20	.18
30	.16
40	.14
50	.12
75	.09
100	.07

The test is an approximation derived from the standard test between two independent proportions. When samples may not be independent, as would be the case when data from two time periods for the same organization were being evaluated, a loss in power must be expected. Several additional constraints were imposed in development of the test, and therefore must be considered when using it. If the MEN value is less than 10, it is recommended that the test not be used. In the development of the tabled values it was assumed that the numbers of minority individuals in the two eligible populations were within 20 percent of one another. It was also assumed that minorities comprise less than 50 percent of each eligible group. If either of these circumstances does not hold in a specific instance, use of the test is inappropriate.

CONCLUSION

This paper has attempted to provide information about some of the statistical properties of an indicator which can be used to measure and assess changes in the manner in which an organization makes personnel-related decisions. To assure that minorities are guaranteed equal opportunity and treatment requires more than just good intentions on the part of decisionmakers and managers. Rhetoric is also insufficient. What is necessary is an examination of facts, and when unfairness is found, an appropriate, timely modification of the relevant system elements. The D.I. offers a succinct mode of description for such data. It can be of value not only for detecting and investigation disparities between minority and majority personnel, but also for demonstrating the absence of a difference when no difference exists. As is the case with any statistical procedure, the user must not make blind application of the tool. It is hoped that the research reported here will facilitate the appropriate and meaningful use of the method to pursue the eradication of institutional discrimination within a variety of organizations.

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